On a can body, including a can casing, which is closed around the can axis and includes a metal layer, and a closure part, which includes a metal layer, a laser connection is produced between the metal layers of the can casing and the closure part in an overlapping region of the closure part and the can casing. In at least one embodiment, the laser connection includes a plurality of perforations along the connecting line, or a plurality of narrowly delimited regions, in which the two metal layers are melted together. A plastic material is arranged on the laser connection. The laser connection ensures stability, and the plastic material ensures leak tightness, of the connection between the can casing and closure part.
CAN BODY AND METHOD AND APPARATUS FOR THE PRODUCTION THEREOF

[0001] The invention relates to a can body according to the introductory part of claim 1, to a method for the production of can bodies according to the introductory part of claim 10 and to an apparatus for the production of can bodies according to the introductory part of claim 13.

[0002] Aerosol can bodies are formed in one part or in several parts. For one-part aerosol aluminum cans, a cylindrical can body is prepared by cold impact extrusion. Afterwards, a valve seat is formed at the open end by means of jolt necking. This method of production is very expensive due to the installation necessary for many processing steps and due to the water and energy requirements for cleaning and drying. U.S. Pat. No. 4,095,544 and EP 0666124 A1 describe the production of seam-less steel cans. In doing so, the cylindrical can body is produced by stamping, pressing and stretching from a steel sheet coated with tin or with plastic material. It has turned out that enormous problems occur with forming a restricted can neck, because the material's structure has changed and has hardened due to stretching.

[0003] Very dispersed are also can bodies of sheet metal material, where the shell comprises a longitudinal welding seam. Bottom and the upper closing are attached to the can shell via saddle joints. With saddle joints, sealing problems can occur, which may be reduced using sealing rings. With the current thin-walled cans, problems will result with a sealing arranged on the front side.

[0004] From WO 05/000498, a solution is known, where to a can shell, closed by a butt-jointed longitudinal laser seam, a can bottom is fixed at the lower front side by means of a laser seam. At the upper front side, a restriction is formed. To this end, a shaping roller is pressed from outside against the turning can shell. In the interior of the can shell a support edge is arranged, which cooperates with the shaping roller and is moved during restriction in the direction towards the upper front side. At the restricted end, a closing element comprising a valve seat is welded on. Optionally the upper end of the can shell is restricted by jolt necking or by spin flow necking, wherein this restriction can be carried out up to forming a valve seat. The valve seat is formed by the can end deformed to the exterior, wherein the valve seat, in a cross-sectional plane which comprises the can's longitudinal axis, is substantially circular. The free end extends from inside to outside and from outside back towards the exterior of the restricted can shell. With the valve seat, it is the matter of a so-called outward curl or an outward edge flange.

[0005] From WO 05/068127, a solution is known, where a can shell, comprising a butt-jointed longitudinal laser seam, is pressed for shaping radial to the exterior into an inner mold. At the lower front side of the can shell, a can bottom is welded on. At the upper front side, a closing element including a valve seat is arranged by means of a laser seam. Optionally, a restriction process is carried out, such as jolt necking or spin flow necking, instead of an upper closing element at the upper end. This restriction may be carried out up to forming the valve seat. The embodiments illustrated show outward curls or outward edge flanges.

[0006] It is the object of the present invention to find a solution by which stable and tight cans can be produced in a simple and cost effective manner.

[0007] This object is achieved by, the characteristics of claim 1, of claim 10 and of claim 13. The dependent claims describe preferred or alternative embodiments.

[0008] For fixing a closing part arranged at the front side of the can wall, solutions are known from prior art, wherein a tight ring-shaped closed welding seam is produced by means of a laser welding seam. It has been shown that with such continuous laser welding seams, the contact areas of the two parts to be connected, which abut to each other, should have no contamination and no coating. Otherwise, there is the risk that portions of the contamination or coating explosively pass over into gaseous condition, due to the strong heat developing in the seam area, create interruptions of the seam and, thus, leaky sites. To overcome this disadvantage, there is the task for any cans, to find a connection by which no disturbances of the connection can by caused by small contaminations or by coatings.

[0009] For solving this problem, one has recognized in a first step that the metallic layer of the closing part and the laser connection between these layers have only to guarantee stability of the can. Tightness with a laser connection can be achieved by a continuous inner coating or by plastic material, wherein the plastic material is tightly connected to both parts.

[0010] In a second step, one has recognized that a laser connection including many interruptions along the line of connection and a plurality of narrowed areas, wherein the laser beam has molten the two metallic layers, introduces less heat, and the risk of explosion-like development of gas is very much reduced.

[0011] This approach, comprising a plurality of narrowed metallic connection points plus the tightening plastic material, can be used with all cans and closing elements having a metallic layer and, thus, is not limited to aerosol cans and, of course, not to special aerosol cans exhibiting an inward edge flange.

[0012] A further advantage of such a circular laser connection showing a row of narrowed connection areas consists in that it can be carried out with a laser scanning apparatus. This means that the laser beam, for example by a moving mirror, is guided along the line of connection, wherein the laser is alternately allowed to pass or is interrupted so that connections and interruptions are correspondingly created. Due to the scanning possibility, one can do without turning the can to pass over the exit site of the laser beam. Even the laser exit head does not need to be moved along the line of connection.

[0013] If the can neck or the valve seat of an aerosol can is produced as a separate part to be connected with a necked or restricted can shell, the welding connection, according to a preferred embodiment, is carried out with welding areas interrupted in peripheral direction, particularly with point-shaped welding areas.

[0014] Such an interrupted welding connection can advantageously also be used for fixing the can bottom to the can shell. The can bottom can be pressed from the interior of the can against a restricted end region of the can shell, and can then be fixed in a slightly overlapping manner by an interrupted laser connection to the restricted region. If, for example, there is no access from the end of the can shell opposite the can bottom, so as to be able to bring the can bottom into the interior of the can shell and then to the desired fixing region, there is the possibility to bring a can bottom through the restriction, directly at its fixing region, into the interior of the can shell.
Since the radius of the can bottom is larger than the radius of the opening at the restricted fixing region of the can bottom, the round cross-section of the can shell at the fixing region of the can bottom is deformed into an oval free cross-section by a small pressure or by means of squeezing. In doing so, the opening’s cross-section enlarges in a first direction and becomes smaller in a second direction perpendicular to it. If now the can bottom is tilted relative to the plane of the oval opening, it can be introduced into the interior of the can shell, and can be pressed from the interior against the restriction after introduction and after tilting it back. In the region of overlapping, the can bottom can be fixed to the can shell by a laser connection having interruptions. With annular or disc-shaped plastic material inside along the laser connection, a continuous and tight inner coating can be achieved.

In the case of longitudinal seams, the heat peak flowing with the formation of the seam results in undesired frizzling, where it can no longer flow any further. This problem does not occur, if long continuous longitudinal seams are formed and the can shells are severed from the emerging tube. Now it has been found that the problems in the production of can shells from shell blanks or metal sheet can also be solved by forming a laser connection with many interruptions, instead of a continuous laser seam, is formed along the line of connection. The interruptions prevent flowing together of a certain amount of heat and, therefore, heat spreading problems at the end of a connection or of a shell blank are excluded. Such a longitudinal can shell connection comprises a plurality of narrowed regions, wherein the laser beam has fused the two overlapping metallic layers. If the material of the can shell is coated inside, and a continuous inner coating of the can shell is desired, plastic material is arranged in the interior of the can, and is tightly connected to the inner coating at the two sides of the seam.

According to another embodiment, the can shell with a formed valve seat is shaped by a radial enlarging pressing step at an inner mold, wherein the inner mold, preferably, corresponds to a desired final shape of the can shell. The inner mold can comprise any shape deviating from a cylindrical one and can have décor structures. In doing so, the valve seat and, thus the can shell, is held into the inner mold during pressing. The valve seat is not enlarged. By holding the can shell at the valve seat, a defined position of the can shell relative to the inner mold is ensured. For pressing, an elastic press mandrel, to be biased by a pressurized fluid, is introduced into the can shell.

When shaping in the inner mold, a shape can be formed at the free end of the can shell opposite the valve seat, which corresponds to the connection region of a can bottom. The can bottom is subsequently fixed to the can shell by a laser connection.

According to another embodiment, the free end of the can shell, associated with the can bottom, is optionally only engaging its outer mold, after the can bottom has been introduced. This procedure is possible with all cans, where a can shell is connected to a can bottom during production. For necking the can end after insertion of the can bottom, preferably a curling process is used. Therein, a rotating roller is moved relative to the can shell around its circumference. At the can bottom introduced and held there, and preferably at the shaping roller too, the desired necking contour for the neck region of the can shell is formed. During rolling procedure, the can shell is tightly pressed to the region of contact with the can bottom.

The marginal edge front surface of the can bottom is situated in the interior of the can or inside the can, and the marginal edge front surface of the can shell is outside the can shell or at the exterior of the can. If the outer side of the can shell is provided with a décor, the décor extends downwards substantially down to the base surface. Therefore, the can is esthetically particularly appealing and differs from cans, where the region of curvature from a cylindrical shell to the can’s bottom is not provided with a décor.

In order that the shoulder-shaped, matching regions of the can bottom and the can shell, where the cross-section is reduced towards the marginal edge front side of the can shell, engage each other completely tightly, the can bottom, situated inside, can optionally be moved slightly in the direction of the can’s axis towards the exterior, so that the engaging region of the can shell is minimally expanded and is brought into tight contact with the can bottom. In the region of this tight contact an annular closed laser connection between can shell and can bottom can be applied.

Within the scope of the invention, it has been recognized that a peripheral laser seam between overlapping regions of the can bottom and the can shell, particularly at the front side of the can shell does not need to be tight. Preferentially, the peripheral laser seam has the task to connect stably the can shell to the can bottom. Even with the inner pressure necessary for aerosol cans, the seam shall not burst. It has been found that a stable connection, the tightness of which however is not ensured, is achieved at distinctively smaller costs than an absolutely tight peripheral laser seam. This is due to the fact that the peripheral laser seam is very narrow, for example having a width of substantially 0.15 mm. If now a small contamination is in the area of the seam on one of the parts to be interconnected, an explosion-like vaporization of contamination portions, particularly fat or oil portions will occur during welding. At these sites, short interruptions of the peripheral laser seam may result.

Since the can bottoms are preferably manufactured at a different production location, in some cases using a production and shaping process which employs a lubricant, contaminations from the production or from transport can hardly be completely eliminated at justifiable expenses. However, it is possible at smaller expenses to incorporate a barrier inside the can between the can bottom and the can shell, which closes the can’s interior at the laser welding seam tightly against the outside. Since with the possibly untight sites of the peripheral laser seam it is the matter of extremely small passages, the barrier does not need to absorb large forces.

In order to be able to provide a tight barrier by small expenses between the can shell and the can bottom, in the region of the peripheral laser seam or with a laser connection having a row of narrowed interconnection areas, it is according to a further preferred inventive solution, claimed even independently from the independent claims as an invention, plastic material is arranged in the can’s interior along the entire annular peripheral laser seam or laser connection, which is tightly connected to the can bottom and the can shell. In this way, any access from the can’s interior to the peripheral laser seam or to the laser connection is excluded. The peripheral laser seam or the laser connection ensures the necessary strength, while the plastic material connected to the bottom and the can shell guarantees tightness.

Plastic material can be applied as a ring or a disc with its ring margin along the peripheral laser seam onto the
can bottom, can be sprayed by a nozzle or can be built up on the can bottom by an injection molding step. Prior to or after forming the peripheral laser seam, a tight connection of the ring to the can shell, and optionally to the can bottom, is achieved at both sides of the peripheral laser seam.

[0026] The sealing plastic material along the peripheral laser seam between the can bottom and the can shell can be particularly used in an advantageous manner, if the can shell comprises inside a layer of plastic material, be it in the form of a coating or, as preferred, as a film. A can bottom comprising plastic layer, which faces the can’s interior, which protrudes towards the can’s interior or upwards beyond the metallic edge of the can bottom along the radial external edge may be introduced into a cylindrical can shell having an inner layer of plastic material. After insertion, a radial outer contact area of the layer of plastic material of the can bottom engages the inner layer of the can shell.

[0027] Various embodiments and steps for assembling the areas of the can shell and the closing element are possible with the laser connection. This is confirmed by the following examples.

[0028] If the can shell, in that end region where the can bottom is arranged, is slightly narrowed, the can bottom has a slightly larger outer radius than the passage opening of the can shell. If the round cross-section of the can shell is deformed in the fixing region of the can bottom with a small pressure or by squeezing, to have an oval cross-section, the opening’s cross-section enlarges in a first direction and becomes smaller in a second direction perpendicular to the first one. The can bottom is tilted relative to the plane of the oval opening slightly about an axis, which is substantially parallel to the first direction, and is then introduced into the interior of the can shell. After insertion, it will be tilted back and is pressed against the restriction in the interior of the can shell. In the overlapping region, the can bottom can be fixed to the can shell by a laser connection. With ring-shaped or disc-shaped plastic material inside along the laser connection, a continuous and tight inner coating can be achieved.

[0029] As has been described above, the end region of the can shell can be deformed in a deforming step to match with a shoulder-shaped contact surface of the can bottom and can be fixed by a peripheral laser seam. In a heat treatment step, the layer of plastic material of the can bottom is connected to the inner layer of the can shell in the region of contact. To this end, the layer of plastic material of the can bottom comprises optionally a sealing material at least in the area of the connection desired. The heat treatment step is optionally carried out prior to the deformation step so that the can bottom adheres already slightly to the can shell already during deforming.

[0030] If one should do without a deformation of the can shell at the can bottom after introducing the same, a receiving area in form of an ring groove can be formed for a corresponding contact area of the can bottom which protrudes to the exterior. The can bottom should be pressed from outside and from below against the can shell so that the contact area of the can bottom reaches the receiving area of the can shell and is held in it. Now a ring groove area of the can bottom convex from the exterior is in a ring groove area of the can shell, which is concave from the interior. The marginal edge front surface of the can bottom is in the interior of the can or at the inner side of the can, and the marginal edge front surface of the can shell is outside the can shell or at the exterior of the can.

[0031] At the free lower end of the can shell, i.e. at the can bottom, the cross-section of the can shell increases slightly in upwards direction, and is reduced again. The lower restriction of the cross-section has to be very small so that the can bottom, with the maximum outer diameter, can be pressed into the interior of the can shell. When pressing it in, the shell region at the lower restriction of the cross-section will elastically slightly expand and/or the can bottom, at its maximum outer diameter, will be slightly narrowed. With the can bottom pressed in, a shoulder of the can bottom engages a corresponding shoulder of the can shell along the entire circumference. In this shoulder region, the cross-section of the free end of the can shell is reduced so that an abutment is formed. The peripheral laser seam will be formed in a circular closed manner along the shoulder regions being pressed against each other. After the restricted shoulder region, the diameter of the can shell increases again. From the exterior a deepened groove will be seen at the shoulder region and directly above it.

[0032] It is advantageous, if the contact area of the can bottom is introduced into the interior of the can shell. The thickness of the can bottom is mostly chosen slightly larger than the thickness of the can shell. Correspondingly, the shoulder area of the can bottom is slightly more stable in shape than the shoulder area of the can shell. An optimum press fit is achieved, if the more stable shoulder area is pressed from inside against the slightly less stable shoulder area. The outer shoulder area is optionally slightly stretched in circumferential direction, but the inner and more stable shoulder area will not be deformed and not be jolted. If the can shell were inside and the more stable can bottom were outside, jolt wrinkles could develop in the can shell due to the pressing force, which would prevent a tight peripheral laser seam.

[0033] In order to ensure a continuous inner coating at the transition from the can shell to the can bottom, the can bottom is coated inside and is provided with a meltable sealing bead. The can shell is coated with a film, wherein no coating is provided in the shoulder area for the connection with the can bottom. The outer side of the can bottom, which is opposite the can’s interior, has no coating at least in the shoulder area. The peripheral laser seam is now formed between the directly engaging metallic areas of the can shell and the can bottom. To coat the marginal edge front surface of the can bottom, which is situated in the can’s interior, and the uncoated area of the can shell joining to it, the meltable sealing bead is heated and is, thus, caused to flow and subsequently to solidify, so that the material of the sealing bead forms a complete connection between the inner coatings of the can shell and of the can bottom.

[0034] In order to provide a protective coating at the bottom side of the can, an outer bottom cover, preferably in the form of a plastic bottom, is attached to the lower can end. If the bottom cover extends slightly from the can bottom along to the can wall, it can engage the deepened groove directly above the peripheral laser seam. Thus, the bottom cover covers the lower marginal edge front surface of the can shell and the peripheral laser seam. If the bottom cover is tightly connected to the can shell at the deepened groove and the can wall comprises an outer film, the metallic layer of the can shell and of the can bottom is tightly closed towards the exterior and oxidation problems can be excluded. Since the bottom cover, preferably, extends over the entire can bottom, an outer coating of the can bottom can be omitted.
The various processing steps can be effected on turntables which, however, is relative expensive due to the synchronized handing over and due to the holding and transferring elements matching the can diameter. The performance of throughput can advantageously be achieved with a solution, where several linear processing lines are provided in parallel. In front of the individual processing stations, storage areas can be foreseen, from which the can bodies, being partly assembled, are directed to the parallel processing lines. If the production is changed from cans having a first diameter to cans having a second diameter, there are only few elements in the parallel linear processing lines which have to be adapted to the changed diameter.

By the inventive process steps, it is possible to produce cans having very thin can shells. For producing the can shells, steel sheet material of a thickness of substantially merely 0.16 mm can be used. Optionally, even metal sheet of a thickness between 0.16 and 0.12 may be used.

With a can body according to the invention, comprising a can shell closed around a can axis and including a metallic layer, and a closing part including a metallic layer, a laser connection is formed between the metallic layers of the can shell and of the closing part in the overlapping area of the closing part along a line of connection. The laser connection comprises many interruptions along the line of connection and a plurality of narrowed areas, where the two metallic layers are interconnected. At the laser connection, plastic material is arranged. The laser connection ensures stability, and the plastic material ensures tightness of the connection between the can shell and the closing part.

In the process according to the invention for the production of a can body according to the invention, a laser connection having many interruptions is formed between the metallic layers of the can shell and the closing part along the line of connection and a plurality of narrowed areas, where the two metallic layers are fused together. At the laser connection, plastic material is arranged, wherein the laser connection ensures stability, and the plastic material ensures tightness. The areas where the two metallic layers are fused together, are preferably processed with a laser scanning device, wherein the laser beam is guided, for example by mirror movements, along the line of connection or along the overlapping area, and is alternately emitted or interrupted so that interconnections and interruptions are created.

An apparatus according to the invention for the production of a can body according to the invention comprises a laser welding device and a holding device for holding the can shell and the closing part, wherein the laser welding device includes a laser scanning device, which fuses the two metallic layers together in a plurality of narrowed areas by a scanning laser beam. The laser scanning device comprises a control unit, a laser source, which provides the scanning laser beam for the desired time periods, and at least two mirrors or reflection surfaces rotatable about two axes perpendicular to one another, wherein the scanning laser beam from the laser source reaches the respective desired site of the overlapping area via the two rotatable mirrors or reflection surfaces, while the holding device holds the can shell and the closing part in a fixed position.

The drawings elucidate the solution according to the invention with reference to embodiments. It is shown in FIGS. 1a, 1b, 1c vertical cross-sections of the connection of the upper closing part together with the can shell, FIG. 2a a detail in a plan view onto the connection of the upper closing part with the can shell, FIG. 3a a schematic illustration of an apparatus for connecting the upper closing part to the can shell, FIG. 4a a schematic illustration of a scanning laser device for forming a circular laser connection, FIG. 4b a vertical cross-section of a detail of the connection of the can bottom to the can wall, FIG. 4c a plan view of a detail of the connection of the can bottom to the can wall, FIGS. 5a, 5b, 5c vertical cross-sections of the can shell and the can bottom during insertion of the can bottom, FIGS. 6a, 6b, 6c schematic plan views of the can shell and the can bottom during insertion of the can bottom, FIG. 7a front side view of a can shell produced from sheet material by means of a laser connection, FIG. 7b a lateral view of a can shell produced from sheet material by means of a laser connection, FIGS. 8a, 8b enlarged details of vertical cross-sections of the laser connection of the can shell, FIGS. 9a and 9b vertical cross-sections of a detail of the connection of the can bottom to the can wall, and FIG. 10 a vertical cross-section through a beverage can, wherein alternative embodiments are represented at left and at right, where the positions of the can shell and the closing part are different in the overlapping area.

FIGS. 1a, 1b, 1c and 1d show the upper end, restricted to a neck portion 4, of a can shell 3, held by a holding device not shown. On the inner side of the can shell 3 is arranged an inner film 3b, and on the outer side is an outer film 30 or an outer coating. From below, a holding mandrel 34 is inserted to the upper closing part 33 towards the upper opening of the can shell 3. The upper closing part 33 comprises a valve seat 5 with an inward edge flange 6 and with a sealing ring 7 inserted into the inward edge flange 6. In order to ensure precise positioning and pressing of the upper closing part 33 against the neck portion 4, the holding mandrel 34 comprises a centering projection 34a and a press surface 34b. The upper closing part 33 with its overlapping area 33a, adapted to the necking of the can shell 3, is pressed by the press surface 34a against the corresponding surface of the neck portion 4.

To connect the upper closing part 33 firmly and tightly to the can shell 3, an upper press ring 36 is put from above onto the neck portion 4. A heating device 36a is formed and arranged in such a manner that heat can be directed from the outer connection area 35b of plastic material 7a, wherein a hot sealing connection is formed between the outer connection area 35b of the plastic material 7a and the inner film 3b. If the plastic material 7a is formed in one piece with the sealing ring 7, a continuous inner coating is created from the inner film 3b up to the sealing ring 7.

The metallic layer of the can shell 3 is connected to the metallic layer of the upper closing part 33 in the overlapping area 33a by a scanning laser beam 37. The generated laser connection comprises in the overlapping area 33a a plurality of narrowed connecting points 38, where the laser beam has fused the two metallic layers together. It has turned out that the material of the inner film 3b, by bringing in laser energy in a point-shaped manner, goes away from the center of the laser beam, and the two metallic layers interconnect with one another without any disturbance via bolt-shaped fusion areas 39 fused into one another and solidified. Time and power, with which the laser beam produces a connection point 38 is chosen in a way that the fusion area 39 does not
pass completely through the metallic layer of the upper closing part 33 and the plastic layer 7a is not affected. Various grids and, optionally, various cross-sectional shapes of connection points are possible, at least one row along the periphery being necessary. By controlling the scanning laser, the arrangement and the shape of the connection areas or of the connection points may be changed at small expenses.

**[0057]** FIG. 2 shows an embodiment of an apparatus for connecting the upper closing part to the can shell. In a continuously moving chain or band device 40, protruding holding mandrels 34, including a centering projection 34a and a press surface 34b, are mounted, wherein several rows of holding mandrels 34 may be arranged side-by-side to provide several can shells 3 in parallel with upper closing elements 33. In a first loading space 42, upper closing elements 33 are put onto the holding mandrels. In a second loading space 43, the can shells 3 are put onto the holding mandrels 34 over the upper closing elements 33.

**[0058]** An upper press ring 36 is put from above onto the neck portion 4 of the can shell 3 and achieves with a heating device a sealing connection of the connection area 35b of the plastic material 7a to the inner film of the can shell 3. Afterwards the metallic layer of the can shell 3 is connected to the metallic layer of the upper closing part 33 by a scanning laser beam 37. Since the can parts do neither need to be rotated nor is the laser source to be circularly moved, the laser connection can be built up in a simple manner. In a dispensing area 45, the can shell 3 together with the upper closing part 33 are dispensed for conveying them to a further can processing station.

**[0059]** FIG. 3 shows a laser scanner device 46, which forms, along a circular line by the scanning laser beam 37, a laser connection comprising a plurality of narrowed areas, in which the laser beam has fused two metallic layers. In the treatment step shown, a can bottom 13 is pressed from the interior against a lower restriction of the can shell 3, and is fixed by the laser connection. In the can’s interior a holding mandrel 34 presses the can bottom 13 against the restriction of the can shell 3, while the can shell 3 is held by the press ring 36 against the can bottom 13.

**[0060]** The scanning laser beam 37 from a laser source not shown reaches the circular area, where the laser connection shall be formed, via two mirrors 47 or reflection surfaces rotating about axes perpendicular to each other. A control unit not shown and two drives 48 determine the rotational position of the two mirrors 47.

**[0061]** It goes without saying that instead of the can bottom, a different closing element could be attached to the can shell 3 by the scanning laser device 46. In addition, the closing element could also be arranged on the front outside. This solution is, thus, not limited to aerosol cans and, of course, not to special aerosol cans exhibiting an inward edge flange.

**[0062]** FIGS. 4a and 4b show a laser connection produced by the scanning laser device 46. It comprises in the overlapping area of the interconnected parts a plurality of narrowed connection points 38, where the laser beam has fused the two metallic layers together. It has turned out, that the material of the inner film 3b, by bringing in laser energy in a point-shaped manner, goes away from the center of the laser beam, and that the two metal layers interconnect with one another without any disturbance via bolt-shaped fusion areas 39 fused into one another and solidified. Various grids of connection points are possible, at least one row along the periphery being necessary. By controlling the scanning laser, the arrangement and the shape of the connection areas or of the connection points may be changed at small expenses.

**[0063]** The can shell 3, at the can bottom 13, is slightly restricted to form a shoulder. The can bottom 13 has a correspondingly shaped overlapping area, which is firmly welded by the laser connection to the restricted area of the can shell 3. In the can’s interior, along the circular laser connection, plastic material 15 is arranged that is tightly connected along a lower connection area 15a to the can bottom 13 and along an outer connection area 15b to the can shell 3. The plastic material 15 may be put as a ring or as a disc with a ring margin onto the can bottom 13, can be sprayed by a nozzle or can be built up on the can bottom 13 by an injection molding step. If a central covering area of the plastic material 15 covers the middle area of the can bottom 13, a can body may be produced at small expenses, the entire inner surface of which has a plastic coating.

**[0064]** The lower end region of the can shell 3 is tightly engaging the overlapping area of the can bottom 13, which is shoulder-shaped in cross-section. The peripheral marginal edge front surface of the can bottom 13 is in the can’s interior, or at the inner side of the can, and the lower marginal edge front surface of the can shell 3 is outside the can bottom 13.

**[0065]** FIGS. 5a, 5b and 5c, as well as 6a, 6b and 6c, show how to introduce a can bottom 13 through the restricted end region of the can shell 3. As the can shell 3 is slightly restricted in the end region where the can bottom 13 will be arranged, the can bottom 13 has a slightly larger outer radius than the passage opening of the restricted region.

**[0066]** In FIGS. 5b and 6b, the cross-section of the can shell 3 is deformed to an oval cross-section by small pressure or by means of squeezing. In doing so, the opening’s cross-section enlarges in a first direction and becomes smaller in a second direction perpendicular to the first one. The can bottom 13 is held by an introducing holder 49, wherein preferably a sub-pressure is created for holding in a suction contact area 49a. When introducing, the can bottom 13 is slightly tilted by the introducing holder 49 relative to the plane of the oval opening about an axis, which extends substantially parallel to the first direction. In this tilted position, the can bottom 13 is introduced into the interior of the can shell 3.

**[0067]** FIGS. 5c and 6c, show a situation after the can bottom 13 has been tilted back by orienting the introducing holder 49 vertically. To press the can bottom 13 from the interior against the restriction, even after the introducing holder 49 has been removed, the upper front surface of the holding mandrel 34 presses against the can bottom 13 in the overlapping area, the can bottom 13 can be fixed to the can shell 3 by a laser connection. The novel and inventive laser connection, claimed even independently from the independent claims as an invention, including a plurality of narrowed areas, where the laser beam has interconnected the two metal layers, cannot only be advantageously used for connecting a closing element to the can shell 3. Referring to FIGS. 7a, 7b and 8a, 8b a can shell 3 is described which is produced from sheet material by a laser connection. The sheet material is deformed to a tube, wherein the two lateral regions associated to each other engage each other in an overlapping manner in then overlapping area 50.

**[0068]** With tightly engaging lateral areas, a laser connection 51 is formed by a laser, this connection consisting of a plurality of narrowed connection areas. In doing so, either the can shell 3 may be moved relative to a laser emission site, or
the site of impingement of a scanning laser beam 37 is moved along the overlapping area 50.

[0069] In case, the inner space of the can shell 3 has not to be separated completely from the metallic layer of the can shell 3, a connection according to FIG. 8a is sufficient, where a front side, situated in the interior, of the metallic can shell layer is accessible from the interior of the can.

[0070] To be able to ensure a complete inner coating, an inner film 3b or a plastic coating is arranged on the metallic layer of the sheet material for the can shell 3, and on the first front side, which will be situated in the interior of the can shell 3, a plastic bead 52 is arranged. A first connection surface 52a of the plastic bead 52 is directly connected to the inner film 3b or to the coating at the first front side by a sticking or sealing connection. After forming the can shell, a second connection surface 52b of the plastic bead 52 engages the inner film 3b in vicinity of the second front side of the metallic layer of the sheet material. The second connection surface 52b too is tightly connected to the inner film 3b or the coating by a sealing or sticking connection. Can shell having this connection may advantageously be used when producing tripartite cans. Tripartite cans comprising a can shell, which has a longitudinal laser connection 51 exhibiting a plurality of narrowed connection areas 52 and a plastic bead 52 being tightly connected to the inner film 3b or a coating can be produced in a simple manner with high quality.

[0071] FIG. 9a shows a laser connection between a can shell 3 and a can bottom 13, which is produced by the scanning laser device 46. It comprises a plurality of narrowed connection points 38 in the overlapping area 53 of the two interconnected parts 3, 13, where the laser beam has fused together the two metallic layers of the can shell 3 and the closing part or the can bottom 13.

[0072] The overlapping area 53 is an unnaturally closed and extends in cross-sectional planes, which comprise the can axis 2, preferably under an angle in the range of 5° to 85°, particularly of 20° to 70°, more preferably, however, of 30° to 60° with respect to the can axis 2. In this way, tight engagement of the two parts to be connected can be achieved by a pressing force acting between the two parts in the overlapping area 53. In these cross-sectional planes, the can shell 3 extends at the overlapping area 53 from one side up to its marginal edge front surface 3c at one end of the can shell 3. The outer marginal area of the closing part extends at the overlapping area 53 from one side up to the radial outer marginal edge front surface 13c: closing part or of the bottom 13. In the overlapping area 53, the can shell 3 and the closing part have substantially the same shape, so that a respective layer engages the other one without any gap. In the embodiment illustrated, the two parts comprise only one layer in the overlapping area.

[0073] The plastic material necessary for tightness at the laser connection is formed by an outer coating 54 of the can bottom 13. For tightly connecting the outer coating 54 both to the can bottom 13 and the can shell 3 in the overlapping area or at the laser connection, preferably a heat treatment is effected in the overlapping area. To be able to ensure a consistently tight connection of the outer coating 54 to the can shell 3, the outer coating 54 comprises a sealing layer to be connected to the can shell 3 at least at the overlapping area, and the connection of the outer coating 54 to the metallic layer of the can bottom 13 is also a firm and tight connection. The outer coating 54 forms a corrosion protection at the can bottom 13, which is advantageous with cans of steel, because they do not oxidize when put on a wet surface.

[0074] It has been found, that the material of the outer coating 54 goes away from the center of the laser beam, when bringing in laser energy in a point-shaped manner, and the two metallic layers interconnect with one another without any disturbance via bolt-shaped fusion areas 39 fused into one another and solidified. Around the solidified fusion areas 39, the outer coating 54 remains as a sealing layer extending around along the overlapping area 53, thus achieving the desired tightening function. Various grids of connection points 38 are possible, at least one row along the periphery being necessary. By controlling the scanning laser, the arrangement and the shape of the connection areas or of the connection points 38 may be changed at small expenses.

[0075] In the embodiment illustrated in FIG. 9a, neither the can bottom 13 or the closing element, nor the can shell 3 is coated on the can’s inner side. Such cans without an inner coating may be used for all products, where no undesirable reactions between the metallic layer of the closing element or of the can shell 3 and the product are expected which, for example, is the case with polyurethane foams for construction applications.

[0076] The realization of the laser connection illustrated in FIG. 9a may be chosen in an analogous way for the upper closing element, in which case the upper closing element or, optionally, the can shell 3 comprises a plastic coating at least in the overlapping area 53.

[0077] FIG. 9b shows an embodiment of the connection between the can shell 3 and a closing part, particularly a bottom 13, in which connection the radial outer marginal edge front surface 13c of the part situated internally is not accessible from the can’s interior, because a marginal region is folded over by 180° to the exterior at the radial external marginal edge front surface 13c. If the folded marginal region is made to engage the other part, the marginal edge front surface 13c, after forming the laser connection or the connection points 38, is no longer accessible. If the can shell 3 comprises an inner film 3b, and the closing part or the can bottom 13 comprises an inner coating 13d, a continuous inner coating is provided, and the plastic material of the inner film 3b and of the inner coating create tightness. It goes without saying, that the end region of the can shell too can be folded to the exterior in a corresponding manner, if the closing part is engaging the can shell 3 from outside.

[0078] FIG. 10 shows an embodiment in the form of a beverage can 55, where the can bottom, together with the can shell 3, is formed as a deep-drawn, cup-shaped part. At the upper, open end of the can shell 3, the upper closing part 56 is arranged with a tear-off can top device 57. The laser connection between the can shell 3 and the upper closing part 56 comprises a plurality of narrowed connection points 38, where the laser beam has fused together the two metallic layers of the can shell 3 and the upper closing part 56.

[0079] For bringing the can shell 3 and the upper closing part 56 together in the overlapping area 53, there are two possibilities. Either the upper closing part 56, in an analogous way as in the process represented in FIGS. 5a, 5b and 5c, is brought into contact in the overlapping area 53 from the can’s interior (left side), wherein the pressing force has to be achieved by an introducing holder. To enable pressing from the interior, the introducing holder has to be connected to the upper closing part 56 either by a sub-pressure or by a clamping device, because at the can bottom, there is no access to the
can’s interior. The second possibility of assembling consists in that the upper closing part 56, in the overlapping area 53 is brought into contact to the can shell 3 from the can’s exterior (right side), wherein the two parts to be interconnected can respectively be pressed against each other from the exterior. In both variants, the can shell 3 and the upper closing part 56 are formed in such a way in the overlapping area, that the outer contour corresponds to a desired shape of a beverage can.

[0080] The plastic material required for tightness of the laser connection, according to the left illustration, is formed by an inner coating or inner film 3b of the can shell 3, the inner film 3b or the inner coating being situated in the overlapping area between the can shell 3 and the upper closing part 56. For a tight connection of the inner film 3b or of the inner coating both with the upper closing part 56 and the can shell 3 in the overlapping area or at the laser connection, a heat treatment is preferably carried out in the overlapping area. In particular, the inner film 3b or the inner coating comprises a sealing layer facing the upper closing part 56 in the overlapping area.

[0081] The plastic material required for tightness of the laser connection, according to the right illustration, is formed by an inner coating 58 or an inner film of the upper closing part 56, the inner coating 58 or the inner film being situated in the overlapping area between the can shell 3 and the upper closing part 56. For a tight connection of the inner coating 58 both with the upper closing part 56 and the can shell 3 in the overlapping area or at the laser connection, a heat treatment is preferably carried out in the overlapping area. In particular, the inner coating comprises a sealing layer facing the can shell 3 in the overlapping area 53.

[0082] When bringing in laser energy in a point-shaped manner, the inner film 3b or the inner coating 58 goes away from the center of the laser beam, and the two metallic layers interconnect with one another without any disturbance via the bolt-shaped solidified fusion areas 39. The inner film 3b or the inner coating 58 forms a continuous sealing in the overlapping area. It goes without saying, that tightness may be achieved or increased also, or in some cases in addition, by plastic material arranged at the can’s interior, which is connected to the inner film 3b and the inner coating 58, in an analogous way to the explanations in accordance with FIGS. 1c and 4a.

[0083] To prevent parts with an inner coating and/or an inner film to exposure freely the metallic layer of the can shell 3 or of the upper closing part 56 in the can’s interior, a marginal edge front surface of one of the interconnected parts should be coated in the can’s interior. Correspondingly, at the left side, a radial external marginal edge front surface 56c of the upper closing part 56 is coated. In the embodiment according to the right side, a terminal marginal edge front surface 3c is coated at the free end of the can shell 3.

1. Can body comprising:
a can shell closed around a can axis, which includes a metallic layer, and
a closing part, which includes a metallic layer, wherein in an overlapping area of the closing part and the can shell a laser connection is formed between the metallic layers of the can shell and the closing part along a line of connection, wherein the laser connection comprises many interruptions along the line of connection and a plurality of narrowed areas, in which the two metallic layers are fused together, and a plastic material is arranged at the laser connection, and wherein the laser connection ensures stability, while the plastic material ensures tightness.

2. Can body according to claim 1, wherein the areas, where the two metallic layers are fused together, are formed as narrowed metallic connection points.

3. Can body according to claim 2, wherein the connection points form at least one row along the line of connection, in particular being arranged in the shape of a grid.

4. Can body according to claim 1, wherein the closing part is an upper closing part, particularly including a valve seat, but optionally including a tear-off cap top device for a beverage can.

5. Can body according to claim 1, wherein the closing part is a can bottom (13).

6. Can body according to claim 1, wherein the plastic material is arranged in the form of a coating or of a film at least on the closing part or on the can shell in the overlapping area and is situated between the two interconnected metallic layers.

7. Can body according to claim 1, wherein an inner film is arranged on the inner side of the can shell, the material of the inner film being situated between the two metallic layers in those areas, where the two metallic layers are fused together, is displaced by bringing in laser energy in a point-shaped manner, and there are formed solidified fusion areas of the two metallic layers.

8. Can body according to claim 1, wherein plastic material is arranged in the can’s interior along the entire laser connection and is tightly connected to the closing part and the can shell.

9. Can body according to claim 8, wherein the plastic material is arranged in the form of a ring or a disc on the can bottom, and is connected to the can shell radial outside.

10. Method for the production of a can body comprising a can shell closed around a can axis, which includes a metallic layer, and a closing part, which includes a metallic layer, wherein in an overlapping area of the closing part and the can shell a laser connection is formed between the metallic layers of the can shell and the closing part along a line of connection, the method comprising:
forming the laser connection is formed with many interruptions along the line of connection and a plurality of narrowed areas, in which the two metallic layers are fused together, and a plastic material is arranged at the laser connection, wherein the laser connection ensures stability, while the plastic material ensures tightness.

11. Method for the production of a can body according to claim 10, wherein the areas, where the two metallic layers are fused together, are arranged as narrowed metallic connection points in at least one row along the line of connection, but in particular in the shape of a grid.

12. Method for the production of a can body according to claim 10, wherein the areas, where the two metallic layers are fused together, are formed by a scanning laser device, wherein the laser beam, is guided along the line of connection or along the overlapping area and is alternately emitted or interrupted so that connections and interruptions are created.

13. Apparatus for the production of a can body comprising a can shell closed around a can axis, which includes a metallic layer, and a closing part, which includes a metallic layer, and a laser connection, which is formed between the metallic layers of the can shell and the closing part in an overlapping
area of the closing part and the can shell along a line of connection, the apparatus comprising:
a laser welding device; and
a holding device for holding the can shell and the closing part, wherein the laser welding device includes a scanning laser device, which fuses the two metallic layers together in a plurality of narrowed areas by a scanning laser beam.

14. Apparatus for the production of a can body according to claim 13, wherein the scanning laser device provides a control, a laser source, which provides the scanning laser beam for the time periods desired, and at least two mirrors or reflection surfaces rotating about axes perpendicular to each other, wherein the scanning laser beam from the laser source reaches the respective desired site of the overlapping area via the two rotating mirrors or reflection surfaces, and the holding device holds the can shell and the closing part in a fixed position.

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